

Radiation

Safety

Minutes of Radiation Safety Committee of March 10, 2005

Committee

Present: D. Beavis, E.T. Lessard, L. Ahrens, K. Yip, R. Karol, A. Etkin, P. Bergh, D. Raparia, V. LoDestro, B. Briscoe, D. Meany, J. Ritter, and J. Scaduto

An experiment is being setup in the front end of the REF tunnel to study the feasibility of stripping H⁺ beam with a laser. The 200 MeV proton beam will be delivered from the LINAC and dumped in carbon blocks, which are located in the REF tunnel. Two of the carbon blocks are directly underneath Michelson St.

The committee recommends that this experiment can proceed with the conditions listed below.

One of the present recommendations is to turn off the BLIP program while beam is delivered to the REF tunnel. This recommendation can be reconsidered depending on shielding changes and program considerations.

Discussion

Overview of the radiation issues for the experiment and associated figures can be found in attachments 1 and 2.

The experiment has requested the following beam intensities:

1.875*10¹⁰ p/pulse (1 pulse per second)
6.75*10¹⁰ p/hr
2.7*10¹⁴ p/(4 hr day)
4.05*10¹⁵ p/run (run for 3 weeks)

The experiment has asked for a factor of two increase on the total beam (8.1*10¹⁵ p). It is expected that this will be accomplished by increasing the hours per day. It is noted that the dose rate on the road will establish the maximum allowed beam per hour and the potential for soil activation will determine the maximum allowed integrated beam.

(CK-REF-fy2005-434) RSC sign off that the shielding around the known loss points will protect the adjacent soil and satisfy the BNL standard for 8.1*10¹⁵ p/run .

(CK-REF-fy2005-435) On initial operations the surface areas are checked with surveys and found to be acceptable by RCD.

(CK-REF-fy2005-436) A procedure needs to be written and reviewed that establishes how the instantaneous and integrated beam will be monitored. The monitor for instantaneous beam may need to alarm MCR for high beam rates unless a chipmunk protecting the outside areas is shown to provide the equivalent function.

The committee discussed issues of the potential dose to the area above the REF tunnel. The surface area above the section of the REF tunnel where the beam will be transported is an uncontrolled area. A portion of the area is Michelson St (see figure 2. in attachment). 50% of the beam is expected to be lost in the separating beam stops located 8 meters before Michelson St. The slope to the BLIP and LINAC berm starts approximately 4 meters from the road, with a substantial slope. This area should have substantial additional overburden relative to the beam dumps under the road. The dumps under Michelson St. will dominate concerns on dose.

50% of the beam will be dumped in carbon blocks directly under the middle of Michelson St. REF fault studies and simple empirical formulas have been used to estimate the dose rate on the surface of the road. **The estimate is 0.27 – 0.5 mrem/hr for 50% of 6.75×10^{13} p/hr.** Several scenarios were considered for occupancy. The anticipated potential dose to members of the public or staff in this uncontrolled area is not expected to exceed 0.9 to 3.8 mrem. This is expected to be conservative and not to occur. Shielding will be added to the tunnel to reduce potential soil activation. This additional shielding will decrease the potential levels on the road for routine operation by at least a factor of 2. **The routine dose rates on the road should be 0.14 mrem/hr to 0.25 mrem/hr** with a corresponding maximum potential integrated dose (for the duration of the experiment) to people in the uncontrolled area limited to 0.5-2 mrem.

The maximum possible fault could occur if beam intended for BLIP is transported to the REF tunnel. Assuming 10^{15} p/s are transported to the dumps under the road, the dose rate on the road could be 7.5 mrem/s or 27,000 mrem/hr. Credit for a factor of 2 in local shielding over the dumps has been used. The committee was not comfortable recommending that chipmunks be used to protect an on-site road which can be used by the public and staff from this level of fault potential. The committee notes that this dose rate does not violate any rules, but does not seem worth the potential risk at this time. The RSC procedures require that uncontrolled areas be prevented from any single fault giving more than 20 mrem of dose. It is expected that a chipmunk could provide this protection. **The committee does not make this recommendation.**

(CK-REF-fy2005-437) The source shall be reduced in intensity by a factor of 100 using the same technique that is used for RHIC. The maximum potential dose on the road for a fault will then be 0.075 mrem/s or 270 mrem/hr. The source can be unlocked when the REF experiment is not running. This condition reduces the beam time for BLIP. The committee will consider recommending concurrent operation of BLIP and the REF experiment with sufficient shielding changes in the REF tunnel.

(CK-REF-fy2005-438) An interlocking chipmunk be placed in the escape labyrinth. The alarm and interlock level should be established to limit the dose rate on the road. RCD will need to survey the road with beam on the dumps to establish the final setting.

The surveys should establish if beam operations needs to avoid the lunch hour and times when personnel use the road for the North Gate (morning and late afternoon). Experience has demonstrated that warning signs can cause more trouble than benefit.

(CK-REF-fy2005-439) RCD should place a TLD near the edge of the road to get an integrated dose through the berm for the experiments operation.

Special high intensity operations for short durations will be considered once surveys have been conducted. Additional controls may be need for high intensity tests.

Soil activation was discussed. Credit was not given for the road being a potential cap or that the upstream loss point may be partially under the BLIP cap. MCNPX was run for 200 MeV into a carbon block. A distance of two feet was used for the block to the soil. This is the closest distance any of the blocks are from the soil. For an integrated beam total of 8.1×10^{15} protons the Na22 concentration will be a factor of 4 above the BNL standard. Shielding will be added to reduce the concentration to a level below the BNL standard. A combination of steel and concrete will be used to achieve a reduction factor of four or more. MCNPX was run for approximate geometries, which demonstrated that 1 foot of light concrete provides a reduction of 2.5 and 0.5 ft of steel provides a reduction of 3.5. Additional shielding might allow for the concurrent operation of BLIP and REF. Shielding is required for all carbon blocks.

The residual activity of the carbon blocks has not been estimated. The tunnel will be treated as a primary area with beam on. With beam off the residual activity from the carbon blocks will determine whether the area is a radiation area or a high radiation area. Access to the area will be via the standard access procedure for primary areas. This procedure requires a waiting period before entry. Before personnel enter the area an RCT is required to conduct a survey. These procedures should provide adequate protection for the experimenters from exposure. If possible an activation estimate will be conducted. Although consideration for soil activation may not require shielding on the isle side it is recommended that this be added to reduce any potential residual dose to personnel using the isle. There is no controlled access mode planned for the tunnel.

(CK-REF-fy2005-440) An RWP will be prepared for the experiment in anticipation that the experimenters will receive more than 20 mrem of exposure while working in the tunnel after initial beam operations.

(CK-REF-fy2005-441) A sweep procedure will be written for the tunnel. It is recommended that B. Briscoe be allowed to sweep for the tunnel provided it is approval by T. Roser.

There is a closed loop water system providing cooling. The heat exchanger is in the basement.

(CK-REF-fy2005-442) The water in this system should be sampled for tritium after the conclusion of the run.

(CK-REF-fy2005-443) The heat exchanger should be surveyed at initial startup to check the dose rates.

(CK-REF-fy2005-444) Air activation must be calculated and the potential for releases considered. The ventilation system must also be reviewed since the tunnel may be connected to the building ventilation system.

(CK-REF-fy2005-445) All materials to be placed in the beam must receive approval from the CA Chief Mechanical Engineer or his designee. Any concerns for potential contamination should be taken to the ALARA committee for consideration. This should include the vacuum system in the event of a carbon block failure.

(CK-REF-fy2005-446) Penetrations have not been examined in detail. A list of nearby penetrations should be made and checked for potential dose. Of particular concern is the port being used for venting the laser near the upstream carbon blocks. The escape labyrinth will have an interlocking chipmunk to protect the road and the area near the labyrinth.

The interlocks will be a redundant system, which was designed for REF operations about 15 years ago. The tunnel will have crash buttons and cords, warning indicators similar to RHIC, a 30 sec. minimum delay, and require that the concrete door be closed. The critical devices are D3 and D4. Each magnet is interlocked. D4 is a DC magnet and D3 is a pulsed magnet. The interlock system is presently being tested and some updates are being provided. The following concerns need to be addressed before the system is accepted.

(CK-REF-fy2005-447) An appropriate engineering examination of the components should be made since they have not been used for approx. 10 years. Of particular concern would be the devices which interlock the magnets.

(CK-REF-fy2005-448) A estimate of the risk that the charging system for D3 will allow additional pulses to be bent into D4 after the beam is interlocked must be clearly understood. An alternative to using the D3 magnet is to require that the reachbacks automatically turn D2 and D1 off. D1 and D2 turns the beam off for both BLIP and REF.

(CK-REF-fy2005-449) Beam into D4 has the potential to create substantial levels in the front of the REF tunnel. This must be estimated. It is noted that when BLIP was turned on a shield was installed between BLIP transport and the opening in D4. This shield reduces the dose in the front of the REF tunnel due to scrapping in the BLIP. If D3 bends

beam into D4, this shield is not useful and the magnet box becomes a potential radiation source for the upstream end of the BLIP tunnel.

(CK-RHIC-FY2005-Polarized –432) An operations procedure is written which includes testing the transformers once per day. After experience is established the testing frequency can be decreased.

(CK-RHIC-FY2005-Polarized –433) Operations consider how to prevent inadvertently injecting the AGS with pulses intended for BLIP. One concern was that after the high intensity source has been used in low intensity mode (while the polarized proton source is serviced) that an operator could reload the user function to use the high intensity source after the polarized proton source has been put back into operation.

Attachments (file copy only)

- 1) Powerpoint presentation by D. Beavis
- 2) Package of 12 figures

CC: Present

RSC

RSC Minutes file

RSC REF file

L. Mausner